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13. ABSTRACT (Maximum 200 words)

Nanonex is successfully finishing the SBIR Phase-I project and has developed a unique nanoimprint tool, Voyager-I. The tool offers unprecedented fast operation (<60 sec per wafer) and excellent nanostructure uniformity over large area (>4"). Furthermore, Voyager is well suited for precision alignment.

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Under the SBIR Phase-I, Nanonex has redesigned the TOM machines to achieve a user-friendly commercial NIL machine, which is named Voyager-I. The Voyager-I was designed for large wafers size (>6"), large imprint-area-uniformity, and high throughput (sub-minute imprint cycle).

The redesign involves (i) optimization "conformal press" design and process (e.g. gas injection methods and the choices of different gases), for improving the imprint-area-uniformity and the throughput. (ii) Study of optimum lamp heater design and process that can improve the imprint-area- uniformity and the throughput. (iii) Study of optimum cooling design and process that can improve the imprint-area- uniformity and the throughput. (iv) Study of the optimum processes for high throughput NIL by investigation of different temperatures and duration in heating and cooling. (v) Study of optimum machine chamber design that can allow a single machine to perform different NIL methods: from deep 3D imprint in thermal plastic to imprint using uv (or thermal) curable polymers. (vi) Study of the scaling of the new design to large wafers (>6" diameter).

Through the Phase-I, Nanonex has built an alpha-tool of Voyager-I, which is currently being used by a commercial company doing manufacturing of integrated optical devices. As shown in Fig. 1, the alpha-tool of Voyager-I is very compact. It has a foot-print of 26in (length) x 24in (width) x 42in (height). Voyager-I has sub-10 sec cycle for each step (heating, pressing, etc) and a total cycle time less than one minute, as indicated by the temperature and press curves in Fig. 2.

Fig. 1. An alpha tool of Voyager-I, which is being used by a commercial company for manufacturing.

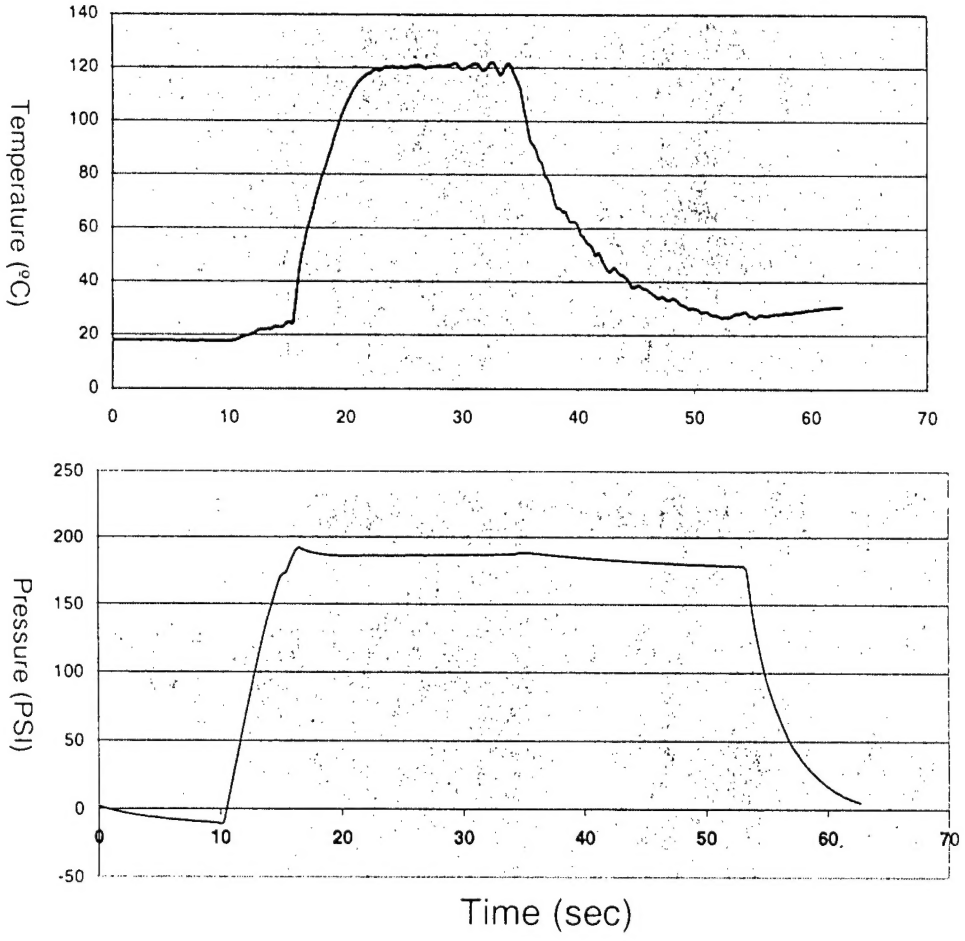

Fig. 2. The change of the temperature and pressure during an imprint cycle, showing a 10 sec for pumping down, 10 sec for ramping the pressure from 0 to 190 psi, 10 sec for heating up from 20 C to 120 C, 15 sec for imprint, and 25 sec for cooling from 120 C to 28 C. The total NIL time without pumping is 55 sec and 65 sec with pumping.